

- [54] **SELF-SIZED PATTERNED BONDED CONTINUOUS FILAMENT WEB**
- [75] Inventor: **Robert J. Brock**, Appleton, Wis.
- [73] Assignee: **Kimberly-Clark Corporation**, Neenah, Wis.
- [22] Filed: **Jan. 21, 1972**
- [21] Appl. No.: **219,751**
- [52] U.S. Cl. **161/146, 156/62.2, 156/180, 156/181, 156/290, 156/306, 161/148, 161/150**
- [51] Int. Cl. **B32b 31/20, B32b 3/00**
- [58] Field of Search..... **161/148, 150, 146; 156/62.2, 180, 181, 290, 306**

| | | | |
|-----------|---------|----------------------|---------|
| 3,509,009 | 4/1970 | Hartmann..... | 161/150 |
| 3,542,615 | 11/1970 | Dobo et al..... | 156/181 |
| 3,542,634 | 11/1970 | Such et al..... | 161/150 |
| 3,692,618 | 9/1972 | Dorschner et al..... | 161/150 |

FOREIGN PATENTS OR APPLICATIONS

| | | |
|-----------|---------|---------------|
| 799,933 | 11/1968 | Canada |
| 1,245,088 | 2/1971 | Great Britain |

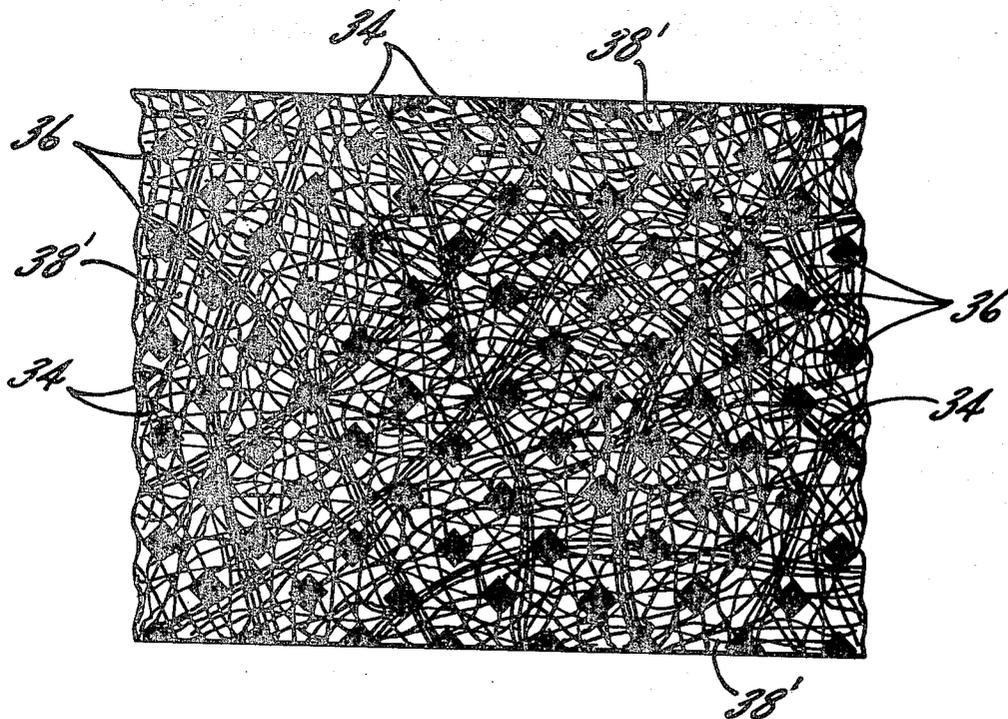
Primary Examiner—George F. Lesmes
Assistant Examiner—J. Cannon
Attorney, Agent, or Firm—Wolfe, Hubbard, Leydig, Voit & Osann, Ltd.

[56] **References Cited**
UNITED STATES PATENTS

| | | | |
|-----------|---------|---------------|---------|
| 2,374,540 | 4/1945 | Hall | 264/6 |
| 3,276,944 | 10/1966 | Levy | 161/150 |
| 3,338,992 | 8/1967 | Kinney..... | 264/24 |
| 3,341,394 | 9/1967 | Kinney..... | 161/72 |
| 3,368,934 | 2/1968 | Vosburgh..... | 161/150 |
| 3,459,627 | 8/1969 | Vosburgh..... | 161/148 |
| 3,502,538 | 3/1970 | Petersen..... | 161/150 |
| 3,502,763 | 3/1970 | Hartmann..... | 264/210 |

[57] **ABSTRACT**
 Self-sized nonwoven webs of substantially continuous and randomly deposited, molecularly oriented filaments which become soft and drapable on use and yet remain strong are disclosed. The webs contain an intermittent pattern of compacted areas within which the filaments are strongly bonded to provide web strength. The filaments adjacent the web surfaces between the compacted areas are lightly bonded to provide initial web stiffness, and disrupt on web working.

8 Claims, 2 Drawing Figures



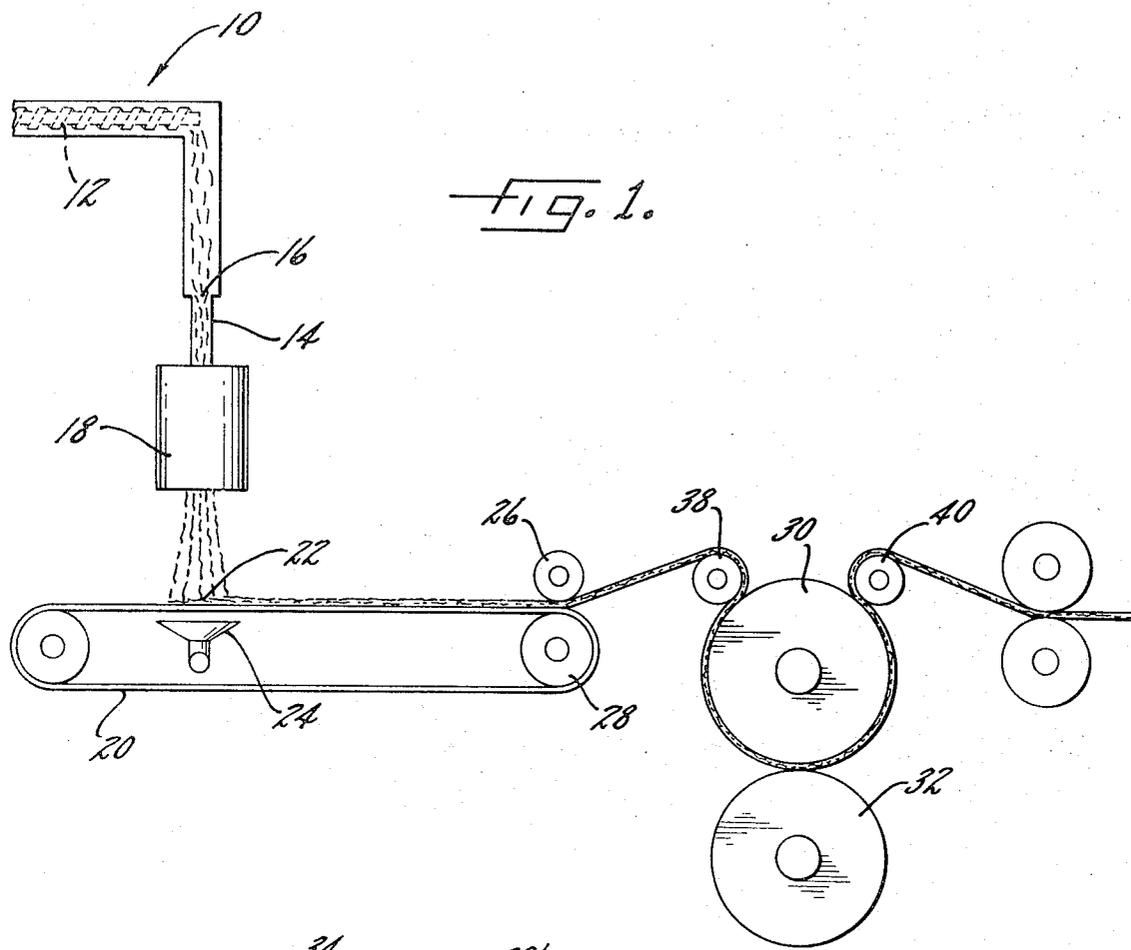


Fig. 1.

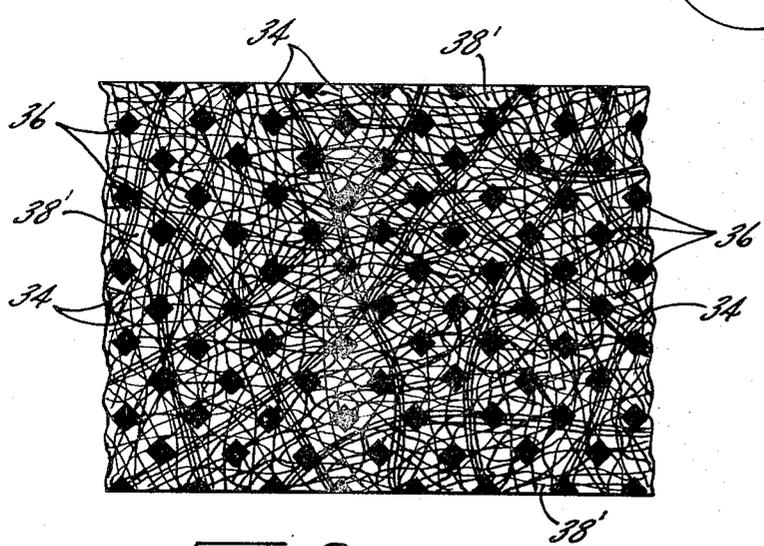


Fig. 2.

SELF-SIZED PATTERNED BONDED CONTINUOUS FILAMENT WEB

BACKGROUND OF THE INVENTION

The present invention relates to fabric-like webs of continuous filaments of a thermoplastic polymer. More particularly, the present invention relates to autogenously bonded webs of continuous filaments which, as initially prepared, possess characteristics resembling a sized material and which become remarkably soft and drapable on subsequent mechanical working.

Nonwoven webs comprised of a plurality of substantially continuous and randomly deposited, molecularly oriented filaments of a thermoplastic polymer are widely known. Among others, the following patents illustrate a variety of methods for preparing such webs: Kinney (U.S. Pat. Nos. 3,338,992 and 3,341,394); Levy (U.S. Pat. No. 3,276,944); Peterson (U.S. Pat. No. 3,502,538); Hartmann (U.S. Pat. Nos. 3,502,763 and 3,509,009); Dobo et al. (U.S. Pat. No. 3,542,615); and Harmon (Canadian Pat. No. 803,714).

While many different methods are illustrated for initially preparing such continuous filament webs, the available methods generally have at least three common features. First, the methods of preparation involve continuously extruding a thermoplastic polymer (either from the melt or a solution) through a spinneret in order to form discrete filaments. Thereafter, the filaments are drawn (either mechanically or pneumatically) in order to molecularly orient the polymer filaments and achieve tenacity. Lastly, the filaments are deposited in a substantially random manner onto a carrier belt or the like to form a web with substantially isotropic physical characteristics.

Continuous filament webs can be formed in the above described general manner which are characterized by a typically fabric-like softness, hand, and drape, and thus appear to be quite suitable for many fabric applications where conventional woven fabrics or the like have been conventionally employed. However, as initially prepared, continuous filament webs are ordinarily very unstable, thus lacking adequate strength to permit their completely successful use in applications such as bed linens, garments, drapery materials, etc. Consequently, it is conventional practice to stabilize the continuous filament webs by bonding together the filaments contained therein either autogenously or by means of independently applied adhesives.

While many known bonding techniques increase the stability of continuous filament webs, problems can still be present in achieving increased stability in combination with other desirable web characteristics such as fabric-like drape, softness and feel. Techniques involving over-all web bonding wherein the filaments in the web are united at substantially all filament cross-over points generally produce a web which is harsh and stiff and, even though the initially stiff and harsh feel of overbonded webs frequently diminishes when the web is actually used, the observed reduction in stiffness and harshness does not generally occur to an extent to render the web aesthetically pleasing unless very light overall bonding is employed. However, light overall bonding is ordinarily undesirable since it is then difficult to achieve adequate strength and surface abrasion resistance.

The problem faced in achieving fabric-like drape, softness and feel in combination with desirable strength

characteristics and surface abrasion resistance was recognized by Hansen and Pennings as first described in U.S. application Ser. No. 15,034 filed on Feb. 22, 1970 which was abandoned in favor of Ser. No. 121,880, filed Mar. 8, 1971, and which application was in turn abandoned in favor of Ser. No. 177,077, filed Sept. 1, 1971. It is therein disclosed that webs having these desirable characteristics can be prepared by an intermittent bonding technique wherein the intensity of the intermittent bonds provides for filament release from the bonds prior to filament fracture when the web is strained. The webs disclosed in the Hansen and Pennings application possess an especially desirable capacity for absorbing energy and are particularly useful in applications such as garments and sheets where, in use, the web is constantly subjected to strains at localized areas such as the toe area in bedsheets and the elbow and knee areas in wearing apparel.

While considerable effort has been centered on achieving desirable strength characteristics in combination with fabric-like drape, softness and feel, the fabric-like characteristics should be manifested by the web in its end use environment and, in fact, their presence prior to actual end use can be a drawback. For example, where the web is quilted to another material, the presence of textile-like qualities during the quilting process is undesirable. The use of a textile-like soft, limp web makes quilting difficult since the web tends to wrinkle as it proceeds through the quilting machine and, accordingly, for use in such applications a web with a functionally useful degree of stiffness is desired. On the other hand, the web stiffness should be temporary since it is desired that the end product should be fabric-like and soft when used in its intended environment. It should be appreciated that the utilization of excessively stiff materials is also undesirable in that such materials adversely reduce the loftiness of quilted fabrics in addition to producing a final product exhibiting a stiff, boardy hand.

Of course, the necessity for using stiff materials in textile processing applications such as quilting has been long recognized. Accordingly, it is customary to size textile materials with starch or the like to make them suitably stiff for processing in quilting machines. The size is generally removed from the quilted material after its first washing or gradually during use, and this accounts for the noticeable increase in softness experienced by purchasers of customary textile materials. However, since sizing involves an additional processing step, it would be desirable to provide a material having sized characteristics without the necessity of independently applying a size.

OBJECTS OF THE INVENTION

Accordingly, it is a principal object of the present invention to provide a strong self-sized nonwoven continuous filament web in which the sized characteristics are greatly diminished on mechanical working accompanying normal use to provide a textile-like material with desirable drape, softness and feel.

A further object resides in providing a web having the characteristics recited in the principal object wherein the accentuation of the textile-like characteristics accompanying use is achieved without a detrimental decrease in the strength of the web.

Closely related to the foregoing object is the further object of providing a web wherein the magnitude of the

accentuation in textile-like characteristics on mechanical working greatly exceeds any accompanying decrease in web strength.

A still further object resides in providing a self-sized nonwoven continuous filament web which can be quilted to provide a material having a bulky, three-dimensional quilted structure.

An additional object resides in providing a web having the foregoing characteristics wherein web sizing and web stabilization to provide strength can be achieved in a single step.

While the invention will be described in connection with preferred embodiments it is to be understood that the invention is not to be limited to those embodiments. On the contrary, all alternatives, modifications, and equivalents as can be included within the scope and spirit of the invention defined in the appended claims are intended to be covered. For example, while the present invention will be described with respect to the preparation of webs containing continuous polypropylene filaments, the invention is applicable to webs containing continuous filaments of other spinnable thermoplastic polymers which have identifiable crystalline melting points to permit the appropriate selection of bonding condition to achieve the hereinafter discussed distinctive combination of variable bond intensities. In addition to polypropylene, other useful polymers include polyethylene, polyamides, and esters such as polyethylene terephthalate as well as mixtures of thermoplastic polymers and copolymers. While the various conditions of temperature and pressure illustrated herein to effect bonding are particularly suitable for polypropylene webs, it is felt that the appropriate conditions for effecting bonding of webs of other polymers in order to obtain the desirable attributes discussed herein will be readily apparent to those skilled in the art.

SUMMARY OF THE INVENTION

Briefly stated, the continuous filament nonwoven webs of the present invention contain an intermittent pattern of discrete compacted areas within which the filaments are strongly and autogenously bonded. The surfaces of the compacted areas are film-like in appearance and, when viewed under a microscope, the presence of extensive fusion between filaments and the loss of filament identity are apparent. The filaments on the web surfaces between the compacted areas are also autogenously bonded together at many of the filament cross-over points to enhance web stiffness. However, the intensity of these autogenous bonds is substantially less than that within the compacted areas with the result that the filaments maintain their separate identity at bond points and the bonds are easily disruptable on mechanical working. The webs illustrated herein possessing this distinctive combination of bond intensities are sufficiently stiff to be processable. Yet, they assume a soft and drapable texture and feel after moderate application in their intended end use environment while remaining strong.

Other objects and advantages of the present invention will become apparent upon reading the following detailed description of the invention and upon reference to the drawing, in which:

FIG. 1 is a schematic side elevation view of apparatus which can be used in preparing webs according to the present invention and

FIG. 2 is a sketch illustrating the surface appearance of a web prepared in the manner illustrated by FIG. 1.

Illustrative methods of preparing webs have the above-described attributes and more detailed characteristics of such webs constructed in accordance with the present invention are presented in the following description.

DESCRIPTION OF PREFERRED EMBODIMENTS

a. Initial Web Laydown

Turning to the drawings, FIG. 1 schematically illustrates one manner in which continuous filament webs of the present invention can be prepared. As shown, polymer 10 is introduced into a conventional extruder 12 and extruded in the form of filaments 14 through a spinneret 16. Drawing of the filaments is then accomplished by passing the spun filaments 14 through a take-off device 18. Thereafter, the filaments are deposited in a substantially random manner on the moving carrier 20 in the form of web 22. Suction means 24 can be present to assist in web formation on the carrier.

With respect to the broad aspects of the present invention, the manner in which the web 22 is initially prepared is not particularly important and any technique for preparing such can be used. However, a particularly useful method of web formation is described in United States patent application, Ser. No. 865,128, entitled "Continuous Filament Nonwoven Web and Process for Producing the Same," filed on Oct. 9, 1969 and now U.S. Pat. No. 3,692,618. This technique permits especially high rates of web formation. The disclosed method involves conventional spinning of continuous filaments of a synthetic polymer by, for example, extruding the polymer through a multiple number of downwardly directed spinning nozzles, preferably extending in a row or multiple number of rows. The filaments, as they are spun, are gathered into a straight row of side-by-side, evenly spaced apart, untwisted bundles each containing at least 15 and preferably from 50 up to 1,000 filaments. These filament bundles are simultaneously drawn downwardly at a velocity of at least 3,000 meters per minute, and preferably from 3,500 to 8,000 meters per minute, in individually surrounding gas columns flowing at a supersonic velocity and directed to impinge on a substantially horizontal carrier. The gathering of the filaments into the untwisted bundles and their drawing and directing to impinge on the carrier is preferably effected by passing the bundles through air guns which surround the filaments with a column or jet of air which is directed downward at supersonic velocity. The air guns are arranged so as to extend in one or more rows extending across the carrier at right angles to its direction of movement, so that the bundles confined in the gas columns as the same strike the moving carrier extend in a line or row at right angles across the carrier. In order to enhance intermingling of the bundles, they can be made to oscillate, the plane of oscillation being transverse to the direction of carrier movement. The carrier can be a conventional carrier used in a nonwoven art, such as endless carrier or belt screen or the upper portion of a drum, as for example a screen drum.

When prepared as described above, the filament bundles, containing a number of parallel filaments, are laid down on the carrier in a loop-like arrangement with primary loops extending back and forth across the

width of a section defined by the impringement of the air column from one air gun on the carrier. Before and as the parallel filament bundles impinge the carrier, they are broken up into sub-bundles containing a lesser number of parallel filaments and forming secondary smaller loops and swirls. The secondary loops and swirls overlap each other, and those of adjacent sections, to result in substantially complete intermingling with the overlapping portions of adjacent sections. Thus, the laid-down filament bundles form a continuous uniform nonwoven web.

b. Aspects of Web Bonding

Referring again to FIG. 1, after formation on the carrier 20, the web is lightly compacted by passage between rolls 26 and 28 to cause slight consolidation and provide sufficient integrity for further processing. In addition, some degree of very light filament bonding at surface cross-over points can be effected by this consolidation step though, since the filaments are generally cool, the degree of bonding at this point is not intense enough to substantially stabilize or stiffen web. Accordingly, after consolidation, the web 22 is placed in contact with the hard smooth surfaced, heated roll 30 by being brought over the idler roll 38. Thereafter, the web is passed through the pressure nip formed by the roll 30 and the hard, heated roll 32 which contains a plurality of raised points on its surface. After passage through the nip, the web remains in forced contact with the roll 30 until it is removed therefrom by passage over the second idler roll 40.

A surface of the web processed in the manner described with reference to FIG. 1 is schematically illustrated in FIG. 2. The compacted areas 36 within which the filaments 34 are strongly autogenously bonded together resemble film-like segments due to extensive fusion between filaments. Fusion is particularly apparent on the web surface side in contact with the roll 32. These compacted areas correspond to the web regions which were in register with the raised points on the roll 32 as the web passed through the roll 30, 32 pressure nip. The intensity of filament bonding within the compacted areas in combination with their distribution and size to a large extent establishes the web's strength characteristics and its eventual drape, softness and textile-like feel.

Still referring to FIG. 2, the regions 38' between the compacted areas have a filamentary appearance and this evidences the absence of substantial filament fusion. However, light autogenous bonding at many of the filament cross-over points in the regions 38' is present. The number of these bonds and the intensity thereof contributes to the sought after initial stiffness of the web.

While the invention has been illustrated thus far in general terms, it should be appreciated that achieving the distinctive combination of bonding possessed by webs satisfying the aims and objectives of the present invention requires careful selection of the bonding conditions. To this end, the temperature of the rolls 30 and 32, the dwell time which the web 22 is in contact with the roll 30, the pattern of the raised points on the roll 32 as well as their height, and the nip pressure are important. The selection of the appropriate conditions is governed by the following considerations.

The dwell time of the web in contact with the roll 30, and particularly the time prior to the nip, should be coordinated with the temperature of the rolls 30, 32 so

that the filaments on the web surfaces achieve a temperature which, while below their crystalline melting point, is sufficiently high to soften the filaments and enable them to cohesively stick together at their cross-over points when the web is subjected to slight pressure. As previously mentioned, these bonds appear to contribute to the self-sizing characteristics of the web. By co-ordinating the dwell time and roll temperatures, they can be fashioned with an intensity and in a number such that adequate stiffness is built into the web for processing on quilting machinery and the like, and yet be subsequently easily disruptable so as not to adversely affect softness and drape in use. Also, as herein-after discussed, dwell time and temperature are important in achieving web strength characteristics.

Turning now to the pattern or configuration of the raised points on the roll 32, the selection of an appropriate pattern is important in achieving web strength while not adversely affecting the textile-like characteristics which the web is capable of developing on working. The pattern of raised points on the roll 32 should be selected such that the resulting bonded web has compacted areas in a density of about 100-500/inch² with the web surface area occupied by compacted areas being about 10-25 percent. Webs containing larger densities of compacted areas are generally not capable of developing desirable drape and softness on working. The presence of high densities also makes it difficult to obtain only light filament bonding in the regions between compacted areas. Similarly, as the total area of compacted regions exceeds the indicated 25 percent, the textile-like characteristics of the web diminish and, particularly with higher densities, it becomes increasingly difficult to achieve the sought after degree of variable bond intensity throughout the web. A compacted area density of at least about 100/inch² and a total occupied area of about 10 percent appears to be necessary in order to achieve adequate web strength.

In combination with the above discussed bonding conditions, the pressure applied to the raised points on the roll 30, 32 nip and the height of the raised points are also important. The pressure on the raised points must be sufficient to intensely bond the filaments within the compacted areas and thereby develop adequate web strength and provide surface abrasion resistance during repeated web usage. Moreover, as discussed in the previously identified Hansen and Penning application, pressure can be an important variable when high levels of web energy absorption are desired.

The height of the raised points on the roll 32 should be less than the thickness of the web entering the roll 30, 32 nip so that, as the web passes through the nip, the surfaces of the web are in contact with the heated rolls. This feature appears to be important in effecting the above discussed light filament bonding between compacted areas. If the raised points are substantially greater than the web thickness, the web regions not in register with the points will not experience the application of pressure and, accordingly, the filaments in these regions will not be forced into sufficient contact to effect the light bonding necessary to yield the self-sized characteristic.

On the other hand, the raised points should be high enough in comparison with web thickness, to assure that the pressure applied to the web in the nip will be

principally located in the web regions in register with the raised points, as opposed to being distributed over the total web surface. This is important in achieving good tensile strength and in avoiding excessively intense bonding in the web regions between the compacted areas with the accompanying result that the web does not materially soften on working. For similar reasons it is desirable to use hard surfaced rolls **30** and **32**, as previously illustrated since such permits the development of high unit pressures primarily in the web regions in register with the raised points, in addition, the use of hard rolls such as steel or the like, permits independent controlled heating and effects good heat transfer.

In accordance with a further aspect of the present invention, it is desirable that the raised points on roll **32** be substantially vertical, i.e., the sides of the points are substantially parallel to each other, though some rounding of the corners may be desirable to avoid filament cutting. By using substantially vertical raised points intense bonding in web regions in register with the top of the raised points is obtained while surface bonds of lesser intensity are created in web regions immediately adjacent to the compacted areas. In combination with other surface bonds formed in the process illustrated herein, the surface bonds immediately adjacent to the compacted areas appear to contribute to the webs desirable initial stiffness.

Accomplishing the present invention in the manner illustrated with respect to FIG. 1 is especially applicable to the preparation of continuous filament webs having a basis weight about 1 oz./yd.² - 3 oz./yd.² with filaments having deniers of about 0.5-10. The thinness of lower basis weight webs makes it difficult to achieve the variance in bond intensity necessary to provide a self-sized product which materially softens on moderate working while remaining strong. With respect to higher basis weight webs, the present invention would appear to have limited applicability since such webs are quite stiff even when only intermittently bonded. In addition with high basis weight webs, it is difficult to achieve the application of localized high pressure in the web regions in register with the raised points without an accompanying adverse distribution of pressure over the total web surface. The present invention is believed to be most applicable with respect to webs having a basis weight of about 1.1 oz./yd.² - 2 oz./yd.² and filament deniers of about 0.8-2.5.

The appropriate bonding conditions for any given web can be readily established by simple experimentation using the guidelines given above. With webs containing polypropylene filaments, and particularly webs having a basis weight of less than about 2.5 oz./yd.² and especially less than about 2 oz./yd.², roll **30** and **32** temperatures of about 290°F. - 350°F. and 280°F. - 330°F., respectively, are useful in combination with pressures on the raised points of about 8,000 - 22,000 psi. and web speeds of about 10-70 meters/minute. Lower web speeds and higher nip pressures and roll temperatures within the recited ranges should be associated with the use of the higher basis weight webs. In combination with these bonding conditions, the raised points on the roll **32** desirably have a height of about 0.010 - 0.030 inches and the idler roll **38** is positioned relative to the roll **30**, **32** nip such that web prewrap on the roll **30** surface prior to the nip is about 15-35 percent. Additionally, about the same web postwrap on the roll **30** surface is also desirably present.

Webs satisfying the aims and objectives of the present invention prepared as illustrated herein are characterized by the combination of (1) a cantilever stiffness length of at least about 1½ inches and, preferably, at least about 1 5/16 inches, (2) at least about a 30 percent reduction in cantilever stiffness length after a single wash cycle, and (3) a basis weight normalized tensile strength of at least about 6 and, preferably, at least about 7. It has been found that webs having these characteristics are very suitable for many applications where initial stiffness is required for web processing and drape, softness and strength are desired in subsequent use. Preferred webs exhibit at least about a 35 percent decrease in stiffness length after a single washing (to at least a stiffness length of less than 1.5) in combination with only a small accompanying reduction in strength (e.g., less than about 20 percent and, preferably, less than 10 percent) such that the webs have a basis weight normalized tensile strength after a single wash cycle of at least about 5 and, preferably at least about 6.5. In addition, the initial web stiffness should not be so great as to give a web cantilever stiffness length of greater than about 2.5 inches and preferably not greater than about 1½ inches. Webs with higher stiffness values, in addition to possessing other drawbacks are previously indicated, cannot be quilted to yield a fabric with pronounced loft in areas between quilted segments.

The decrease in stiffness on washing is believed to be due to the disruption of the light filament bonds between the compacted areas. The absence of a substantial decrease in strength on washing indicates that the bonds within the compacted areas are of an intensity sufficient to withstand a wash cycle.

Furthermore, it has been observed that webs prepared as illustrated herein exhibit a greater decrease in energy absorption as a result of washing than in tensile strength. This observation appears to confirm the presence of the combination of light and strong bonds as above-discussed. The web tensile strength should be only slightly affected, if at all, by a wash cycle since the level of tensile strength is principally established by the strongest bonds present and is not significantly influenced by the presence of weaker bonds. Thus, the presence or absence of the weak filament bonds between the compacted areas should not greatly affect the tensile strength of the web. Energy absorption, on the other hand, is influenced by all of the bonds present in the web. Accordingly, if the light bonds between compacted areas are disrupted on washing while the strong bonds within the areas remain substantially intact, energy absorption should be diminished on washing to a greater extent than tensile strength. As mentioned, the webs prepared as illustrated herein behave in this fashion.

The cantilever stiffness test referred to herein is described in ASTM D-1388. The test is accomplished by placing a one-inch wide strip of the web on a horizontal surface, one end of which abuts against the top end of a 41.5° inclined plane. The test sample is placed with its narrow edge at the juncture of the horizontal and the inclined surface. It is then moved forward over the edge between the two surfaces until the free end bends over and contacts the inclined surface. One half of the length of the fabric between the point of departure from the horizontal surface and the point of contact with the inclined surface is the cantilever stiffness

length. Increasing lengths are associated with increasing stiffness.

Web tensile strength is measured using a conventional Instron testing machine on one-inch wide web samples using a 3-inch gauge length and a cross-head speed of 12 inches/minute. The maximum value of tensile strength (lbs./in.) divided by the web basis weight (oz./yd.² before washing) is the basis weight normalized tensile strength. Energy absorption represents the area under the tensile strength stress-strain curve and can be obtained by either manual calculation or through the use of an automatic integrator.

For the purposes of the present invention, the referred to values of cantilever stiffness length, tensile strength, and energy absorption are the average of values obtained in both the machine and cross directions of the web. Measurements are made on at least five samples in each direction.

The wash cycle used is described in AATCC test method 88B using a standard model 600 KENMORE machine and a 4 pound wash load. A 10 minute wash cycle at 140°F. including a rinse at 105°F. is employed. Drying is effected for about 7 minutes at an exhaust temperature of about 120°F. - 160°F. followed by 5 minutes cool. 8 ounces of Proctor & Gamble GAIN is added to the load.

The following examples illustrate the present invention. Formation of the polypropylene webs used in the examples is accomplished in a manner similar to that

Web bonding is accomplished using apparatus similar to that depicted in FIG. 1. The rolls 30 and 32, for all examples, are steel, 15-inch diameter rolls with means for being heated. The raised points on the roll 32 are about 0.017 inch high and positioned such that the bonded webs contain regularly spaced compacted areas in a diamond pattern in a density of about 200/inch². Each area is a square of about 0.0285 inch on a side with a diagonal of a square positioned in the machine direction. About 17.5 percent of the surface area of the web is occupied by the compacted areas. The idler rolls 38 and 40 are positioned to provide about 15 percent prewrap and postwrap. The bonding conditions employed for the examples are given in Table II:

TABLE II

| Example | 1 | 2 | 3 |
|---------------------|-------|-------|-------|
| Temperature (°F.) | | | |
| Roll 30 | 335 | 340 | 340 |
| Roll 32 | 315 | 320 | 320 |
| Nip Pressure*(psi.) | 14100 | 16500 | 16500 |
| Web speed (M/Min.) | 41 | 25 | 16 |

* On raised points, calculated from the total load applied to rolls accounting for the weight of the rolls and assuming that the nip contains four raised points in the machine direction.

Results of the webs tested in the previously described manner are presented in Table III:

TABLE III

| Example | 1 | 2 | 3 |
|--|--------|---------|--------|
| <u>Before Washing</u> | | | |
| Cantilever Stiffness | | | |
| Length (inches) | 1-7/16 | 1-13/16 | 2-6/16 |
| Tensile Strength (lbs./inch) | 6.4 | 11.6 | 14.6 |
| Basis Weight Normalized | | | |
| Tensile Strength | 6.4 | 7.75 | 6.1 |
| Energy Absorption (inch-lbs./in. ² *) | 1 | 2.5 | 3 |
| <u>After Washing (1 cycle)</u> | | | |
| Cantilever Stiffness | | | |
| Length (inches) | 14/16 | 1-2/16 | 1-8/16 |
| Tensile Strength (lbs./inch) | 7.1 | 10.9 | 12 |
| Basis Weight Normalized | | | |
| Tensile Strength | 7.1 | 7.3 | 5 |
| Energy Absorption (inch-lbs./in. ²) | 1.4 | 2.3 | 2.4 |
| Decrease in Stiffness | | | |
| Length After Washing | 39% | 38% | 37% |
| Decrease in Normalized | | | |
| Strength After Washing | None | 5.8% | 16.5% |
| Decrease in Energy Absorption | None | 8% | 20% |

* Surface area equal to 3 in.²

described in the above-mentioned Ser. No. 865,128. The characteristics of the webs are set forth in Table I:

TABLE I

| Example | 1 | 2 | 3 |
|---|-----|-----|------|
| Basis Weight (oz./yd. ²) | 1 | 1.5 | 2.4 |
| Web Width (inches) | 54 | 54 | 54 |
| Filament Denier | 1.6 | 1.8 | 1.77 |
| Filament Tenacity (grms./denier) | 3.5 | 3.0 | 3.0 |
| Filament Elongation (%) | 130 | 159 | 141 |
| Crystalline Melting Point of Filament (°F.) | 286 | 286 | 286 |

The webs prepared as illustrated above satisfy the aims and objectives of the present invention as previously set forth with the web of Example II being especially preferred. In addition to the desirable web features previously identified, webs prepared in this manner are further characterized by a three dimensional appearance on both sides attributable to the presence of compacted areas with lightly bonded filaments there between.

Furthermore, with respect to the illustrated webs, the degree of fiber bonding is somewhat less on the web side in contact with roll 30 in the nip. This feature appears to be advantageous when utilizing such webs in quilting applications as cover materials, wherein the less intensely bonded side of the web is in intimate contact with the lofty batting typically found in such

structures. In use, the batting fibers can entangle with the filaments on the web surface, thus possibly imparting a desirable degree of stability to the area between quilted segments in the quilted product.

I claim:

1. A nonwoven web having a basis weight of about 1 oz./yd.² - 3 oz./yd.² consisting essentially of substantially identically prepared continuous and randomly deposited, molecularly oriented filaments of a thermoplastic polymer having a denier of about 0.5-10, said web having a multiplicity of discrete compacted areas of autogenous filament bonds distributed in an intermittent pattern on the surfaces in a density of about 100-500 per square inch and occupying about 10-25 percent of web surface area with the web filaments disposed adjacent to the web surfaces in regions between compacted areas being secured together at cross-over points with autogenous bonds of lower intensity than within the compacted areas, said web having a cantilever stiffness length of at least about 1 1/8 inches, basis weight normalized tensile strength of at least about 6, and exhibiting at least about a 30 percent reduction in cantilever stiffness length after a single wash cycle.

2. The nonwoven web of claim 1 having a basis weight of about 1.1 oz./yd.² - 2 oz./yd.².

3. The nonwoven web of claim 2 wherein the filaments have a denier of about 0.8-2.5.

4. The nonwoven web of claim 3 wherein the thermoplastic polymer is polypropylene.

5. A nonwoven web having a basis weight of about 1 oz./yd.² - 3 oz./yd.² consisting essentially of substantially identically prepared continuous and randomly deposited, molecularly oriented filaments of a thermoplastic polymer having a denier of about 0.5-10, said web having a multiplicity of discrete compacted areas of autogenous filament bonds distributed in an intermittent pattern on the surfaces with the web filaments disposed adjacent to the web surfaces between the compacted areas being secured together at cross-over points with autogenous bonds of lower intensity than within the compacted areas, the distribution of compacted areas and intensity of bonding therein being such that the web has a basis weight normalized tensile strength of at least about 6 and a cantilever stiffness length after a wash cycle of less than about 1 8/16 inches and the intensity of bonding at the filament cross-over points between compacted areas and the number of bonds being such that the web has a cantilever stiffness length of at least about 1 1/8 inches and exhibits a reduction in such length, after a wash cycle, of at least about 30 percent.

6. The nonwoven web of claim 5 having a basis weight of about 1.1 oz./yd.²-2 oz./yd.².

7. The nonwoven web of claim 6 wherein the filaments have a denier of about 0.8-2.5.

8. The nonwoven web of claim 7 wherein the thermoplastic polymer is polypropylene.

* * * * *

30

35

40

45

50

55

60

65